Code : 101303

2012 (A)

SOIL MECHANICS

Time : 3 hours   Full Marks : 70

Instructions :

(i) All questions carry equal marks.

(ii) There are **TEN** questions in this paper.

(iii) Attempt any **FIVE** questions.

1. (a) Define the terms 'void ratio', 'specific gravity of particles', 'degree of saturation' and 'dry density'.

(b) Derive a relation among void ratio, water content, specific gravity and degree of saturation.

2. (a) What do you understand by consistency of a soil? How is it determined?

(b) The following index properties were determined for two soils A and B :

Index Property	A	B
Liquid limit	65	35
Plastic limit	25	20
Water content	35	25
Sp. gravity of solids	2·70	2·65
Degree of saturation	100%	100%

Which of the two soils—

(i) contains more clay particles;

(ii) has a greater bulk density;

(iii) has a greater dry density;

(iv) has a greater void ratio?

3. (a) What are the different methods for determination of the coefficient of permeability in a laboratory? Discuss their limitations.

(b) A constant head permeability test was performed on a sand sample 30 cm in length and 20 cm^2 in cross-sectional area. When the loss of head was 60 cm, the quantity of water collected in 2 minutes was 250 ml. Determine the coefficient of permeability of the soil.

4. (a) Prove that the discharge per unit width of an earth dam with a horizontal filter at its toe is the coefficient of permeability times the focal length.

   (b) Why is a filter used on the downstream side of an earth dam? How would you design a filter?

5. (a) What are the different reasons for the pre-consolidation of soils? What is the effect of preconsolidation on the settlement?

   (b) There is a layer of soft clay 4 m thick under a newly constructed building. The over-burden pressure over the centre of the clay layer is 300 kN/m^2. Compute the settlement, if there is an increase in pressure due to construction of 10 kN/m^2. Take $C_c = 0.50$, $G = 2.70$. The water content of the deposit was found to be 50%.

6. (a) What is Mohr's circle? Discuss its important characteristics.

   (b) The result of a CU test on a compacted soil is given below :

Sample No.	σ_3 (kN / m^2)	σ_d (kN / m^2)	u (kN / m^2)
1	70	230	− 20
2	50	550	+ 90

   Determine c and ϕ in terms of (i) total stresses and (ii) effective stresses.

7. (a) Discuss the use of lime in stabilization of soils. What are the physical and chemical changes which take place in lime stabilization?

   (b) An earthen embankment of 10^6 m^3 volume is to be constructed with a soil having void ratio of 0.80 after compaction. There are three borrow pits marked A, B and C having soils with void ratios of 0.90, 1.50 and 1.80 respectively. The cost of excavation and transportation of the soil is Re 0.25, Re 0.23 and Re 0.18 per m^3 of soil respectively. Calculate the volume of soil to be excavated from each pit. Which borrow pit is the most economical?

8. (a) Define earth pressure at rest. Show the earth pressure distribution on a retaining wall, assuming the soil to be dry.

   (b) A retaining wall is 7 m high with its back face smooth and vertical. It retains sand with its surface horizontal. Using Rankine's theory, determine active earth pressure at the base when the backfill is—

   (i) dry;

   (ii) submerged with water table at the surface.

   [Take $\gamma = 18$ kN/m^3, $\phi = 30°$ and $\gamma_{sat} = 21$ kN/m^3]

9. (a) Discuss the friction circle method for the stability analysis of homogeneous slopes. Can this method be used for purely cohesive soils?

(b) A vertical cut is to be made in clayey soils for which tests gave $c = 30 \text{ kN}/\text{m}^2$, $\gamma = 16 \text{ kN}/\text{m}^3$ and $\phi = 0°$. Find the maximum height for which the cut may be temporarily unsupported. For $\phi = 0°$ and $i = 90°$, the value of stability no. is 0·261.

10. Write short notes on any *three* of the following :

(a) Bishop's simplified method

(b) Quicksand condition

(c) Weep holes

(d) Arching in soils

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